

FORM PTO-1390  
(REV. 5-93)U.S. DEPARTMENT OF COMMERCE  
PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

NIP-208

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)

09/674008

International Application No.

International Filing Date

Priority Date Claimed

PCT/JP99/02207

April 26, 1999

April 28, 1998

Title of Invention  
OPTICAL MEASUREMENT INSTRUMENT AND OPTICAL  
MEASUREMENT METHOD

Applicants for DO/EO/US A. MAKI et al (SEE ATTACHED LIST)


Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 18th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
 ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

[X] LIST OF INVENTORS' NAMES AND ADDRESSES.

U.S. Application No. <b>09/674008</b> (if known, see 37 CFR 1.41)		International Application No. <b>PCT/JP99/02207</b>		Attorney's Docket Number <b>NIP-208</b>	
17. <input checked="" type="checkbox"/> The following fees are submitted:				CALCULATIONS	PTO USE ONLY
<u>Basic National Fee (37 CFR 1.492 (a)(1)-(5)):</u>					
Search Report has been prepared by the EPO or JPO ..... \$60.00					
International preliminary examination fee paid to USPTO (37 CFR 1.482) ..... \$670.00					
No international preliminary examination fee (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445 (A)(2)) ..... \$760.00					
Neither international examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(A)(2)) paid to USPTO ..... \$ 970.00					
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2) to (4) ..... \$ 96.00					
<b>ENTER APPROPRIATE BASIC FEE AMOUNT</b> =				\$ 860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492(e)). <input type="checkbox"/> 20 <input type="checkbox"/> 30				+ \$ 0.00	
Claims	Number Filed	Number Extra	Rate		
Total	15 - 20 =	0	x \$18.00	\$ 0.00	
Independent	8 - 3 =	5	x \$80.00	\$ 400.00	
Multiple dependent claim(s) (if applicable)			+ \$270.00	\$ 0.00	
<b>TOTAL OF ABOVE CALCULATIONS</b> =				\$ 1,260.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				\$ 0.00	
<b>SUBTOTAL</b> =				\$ 1,260.00	
Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492(f)). <input type="checkbox"/> 20 <input type="checkbox"/> 30				+ \$ 0.00	
<b>TOTAL NATIONAL FEE</b> =				\$ 1,260.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property.				+ \$ 0.00	
<b>TOTAL FEES ENCLOSED</b> =				\$ 1,260.00	
				Amount to be:	
				Refunded \$	
				Charged \$	
<p>a. <input checked="" type="checkbox"/> A check in the amount of \$ <u>1,260.00</u> to cover the above fees is enclosed.</p> <p>b. <input type="checkbox"/> Please charge my Deposit Account No. 50-1417 in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.</p> <p>c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-1417. A duplicate copy of this sheet is enclosed.</p> <p><b>Note:</b> Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</p>					
<p>SEND ALL CORRESPONDENCE TO:</p> <p>MATTINGLY, STANGER &amp; MALUR, P.C. 104 East Hume Avenue Alexandria, Virginia 22301 (703) 684-1120</p>					
<p> Signature</p> <p>John R. Mattingly Name</p>					
<p>30,293 Registration Number</p>					

NIP-208

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

A. MAKI et al

Serial No.

Filed: October 24, 2000

For: OPTICAL MEASUREMENT INSTRUMENT AND  
OPTICAL MEASUREMENT METHOD

**PRELIMINARY AMENDMENT**

Assistant Commissioner of Patents  
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows.

**IN THE CLAIMS**

Please amend claim 16, and delete claims 15, and 17-19.

16. (Amended) An optical measurement [method] system comprising functions of:

performing an initial display process for selectively instructing any one of selection of optical measurement, analysis of said optical measurement result and completion of a program;

[a process for] inputting items of condition including a measurement mode;

[a process for] displaying a state expressing relationship among light irradiation positions and light

detection positions and measurement positions so as to meet said mode;

[a process for] instructing to form a file for storing said optical measurement result;

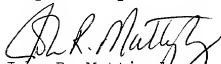
[a process for] instructing a measurement condition to detect light signals from the inside of a body to be inspected which is irradiated by a multi-wavelength multi-channel; and

[a process for] displaying said signals for each channel detected according to said instructing results.

REMARKS

Examination is requested.

Respectfully submitted,



John R. Mattingly  
Registration No. 30,293  
Attorney for Applicants

MATTINGLY, STANGER & MALUR  
104 East Hume Avenue  
Alexandria, Virginia 22301  
(703) 684-1120  
Date: October 24, 2000

Title of the Invention

OPTICAL MEASUREMENT INSTRUMENT AND OPTICAL  
MEASUREMENT METHOD

Inventors

Atsushi MAKI,  
Yuuichi YAMASHITA,  
Tsuyoshi YAMAMOTO,  
Hideaki KOIZUMI.

## TITLE OF THE INVENTION

OPTICAL MEASUREMENT INSTRUMENT AND OPTICAL MEASUREMENT METHOD

## BACKGROUND OF THE INVENTION

5           The present invention relates to an optical measurement system and an optical measurement method, and particularly, to an optical measurement system which is suitable for optically measuring the inside of a biological body and imaging the inside of the biological body based on information signals obtained  
10 by the measurement.

          A technology of easily measuring the inside of a biological body without affecting any ill effect on the biological body is desired in the field of clinical treatment. Measurement using light is very effective for this desire. The  
15 first reason is that oxygen metabolism inside the biological body corresponds to a concentration of specific pigments (hemoglobin, cytochrome a3, myoglobin and so on), that is, light absorbents in the biological body, and the concentration of the pigments can be obtained from an amount of absorbed light  
20 (in a wavelength band from visible light to near-infrared light). The second reason is that light can be easily handled using an optical fiber.

          Systems making use of the advantage of biological measurement using light are disclosed, for example, in Japanese  
25 Patent Application Laid-Open No.63-277038, in Japanese Patent Application Laid-Open No.5300887 and so on. In the systems, light having wavelengths from visual light to near-infrared light is irradiated onto a biological body, and an inside of a biological body is measured from the reflected light detected

at a position 10 to 50 mm distant from the irradiated position. Further, systems for measuring a CT image of oxygen metabolism from light transmitted a biological body having a thickness of 100 to 200 mm, that is, optical CT systems are disclosed, for  
5 example, in Japanese Patent Application Laid-Open No.60-72542 and in Japanese Patent Application Laid-Open No.62-231625.

In regard to clinical application of biological body optical measurement, in a case of measuring, for example, a head there are measurement of an activation state of cerebral oxygen  
10 metabolism and measurement of a local cerebral hemorrhage. In regard to cerebral oxygen metabolism, it is possible to measure higher order brain functions from motion, senses to thinking. In such measurement, the effect of the measurement can be increased larger by displaying the measured result as an image  
15 than by not displaying any image. For example, measurement and display as an image is indispensable for detecting a portion where oxygen metabolism is locally changed.

In a multichannel optical measurement system, it is difficult to speedy detect a channel having a problem unless  
20 correspondence between actual measured positions and measured signals is shown to an operator operating the system.

In addition, there have been problems to cause serious results in the field of clinical treatment unless the operator inputs a large amount of measuring conditions before initiating  
25 the measurement.

#### SUMMARY OF THE INVENTION

An object of the present invention is to provide an optical measurement system and an optical measurement method

which is suitable for optically measuring a body to be inspected and easily obtaining an image of a desired item based on information obtained by the measurement.

In order to attain the above object, in the present invention, measuring positions and a layout of optical fibers specific in the multi-channel optical measurement system are presented to an operator using a display portion. Further, by adding a function of changing the displayed layout corresponding to a measuring signal, it becomes easy to understand the status of the channels. Furthermore, in the present invention, a limited number of windows for inputting measurement conditions are displayed on the display portion, and measurement conditions in the next level hierarchy are displayed after completion of the inputting.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing the construction of the main portion of an embodiment of an optical measurement system to which the present invention is applied.

FIG. 2 is a flowchart showing an example of processing flow in accordance with the present invention for measuring a body to be inspected using the optical measurement system shown in FIG. 1.

FIG. 3 is a view showing an initial window which is shown on a display portion.

FIG. 4 is a view showing a window for inputting conditions which is shown on the display portion.

FIG. 5 is a view showing a window for displaying gain adjusting underway which is shown on the display portion.



FIG. 6 is a view showing a window for displaying measured positions which is shown on the display portion.

FIG. 7 is a view showing a window for display abnormality which is shown on the display portion.

5        FIG. 8 is a view showing a window for forming a file which is shown on the display portion.

FIG. 9 is a view showing a window for forming a directory which is shown on the display portion.

10       FIG. 10 is a view showing a measurement window which is shown on the display portion.

FIG. 11 is a view showing a sub-menu window of Info of FIG. 10 which is shown on the display portion.

15       FIG. 12 is a view showing a window for inputting measurement conditions and display conditions which is shown on the display portion.

FIG. 13 is a view showing a window of Option of FIG. 10 which is shown on the display portion.

20       FIG. 14 is a view showing a window for displaying a measurement data time sequence which is shown on the display portion.

FIG. 15 is a view showing a window for inputting the display conditions of graph of FIG. 14 which is shown on the display portion.

25       FIG. 16 is a view showing a window for inputting a file backup condition which is shown on the display portion.

FIG. 17 is a view showing a window for input setting of the other measurement equipment output signal which is shown on the display portion.

FIG. 18 is a view showing a window for setting a

rectangular wave output signal which is shown in the display portion.

FIG. 19 is a chart showing the rectangular wave output signals of which the conditions are set in FIG. 18.

5        FIG. 20 is a view showing a window for setting an external input trigger synchronous measurement condition which is shown on the display portion.

FIG. 21 is a view showing a window for setting a measured data acquiring condition which is shown on the display portion.

10       FIG. 22 is a view showing a window for checking a measured signal which is shown on the display portion.

FIG. 23 is a block diagram showing the construction inside the light module of FIG. 1.

FIG. 24 is a view showing an example of a geographical arrangement of irradiation positions and detecting positions on a surface of a body to be inspected.

FIG. 25 is a block diagram showing the construction of lock-in amplifier module of FIG. 1.

FIG. 26 is a graph showing an example of time variation of a measured signal at a detecting position and time variation of a predicted no-load signal obtained from the measured signal.

FIG. 27 is a graph showing an example of time variation of an amount of relative change in concentrations of oxygenated hemoglobin and deoxygenated hemoglobin at a measurement position.

FIG. 28 is a view showing a contour image (a topography image) produced from time variation of an amount of relative change in a concentration of oxygenated hemoglobin at each measurement position when motion of left-hand fingers of a

person to be inspected is used as a load.

FIG. 29 is a view showing a contour image (a topography image) produced from time variation of an amount of relative change in a concentration of oxygenated hemoglobin at each measurement position when motion of right-hand fingers of a person to be inspected is used as a load.

FIG. 30 is a view showing an example of a display superposing a topography image on a cerebrum surface image of a person to be inspected.

10

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a block diagram showing the construction of the main portion of an embodiment of an optical measurement system to which the present invention is applied. The present embodiment is that light is irradiated, for example, on the skin of a head and then light penetrating into and scattered by the body is detected from the skin to image the inside of the cerebrum. In the embodiment, number of measurement channels, that is, number of measurement positions is 12. Of course, the object to be measured is not limited to a head, and the present invention can be applied to the other portions and to an object other than a biological body.

A light source portion 1 is composed of four light modules 2. Each of the light modules is composed of a plurality of semiconductor lasers each emitting light having a different wavelength within a wavelength band from visual to infrared, for example, two semiconductor lasers each emitting light having either of 780 nm or 830 nm wavelength. These values of two wavelengths are not limited to 780 nm and 830 nm, and number

of wavelengths is not limited to two. In regard to the light source portion 1, light emitting diodes may be used instead of the semiconductor lasers. The light from all of the eight semiconductor lasers contained in the light source portion 1 is modulated by a oscillating portion 3 composed of eight oscillators having different oscillation frequency, respectively.

FIG. 23 shows the construction inside the light module 2 by taking the light module 2(1) as an example. Semiconductor lasers 3(1-a), 3(1-b) and drive circuits 4(1-a), 4(1-b) for the semiconductor lasers are contained in the light module 2(1). Therein, in regard to the characters in the parentheses, the numeral indicates the number of the light module containing the semiconductor laser or the semiconductor laser drive circuit, and the characters a and b indicate for wavelengths 780 nm and 830 nm, respectively. The semiconductor laser drive circuits 4(1-a), 4(1-b) apply direct current bias current to the semiconductor lasers 3(1-a), 3(1-b), and also apply voltages having frequencies  $f(1-a)$ ,  $f(1-b)$  different from each other to the oscillators 3, respectively, to modulate light beams emitted from the semiconductor lasers 3(1-a), 3(1-b). The modulation in the present embodiment is analogue modulation using sinusoidal waves, but of course, digital modulation using rectangular waves having time intervals different from each other may be used. Each of the light beams modulated as described above is introduced into each of optical fibers 6 through each of condenser lenses 5 for each of the semiconductor lasers. Each of the light beams of the two wavelengths introduced into each of the optical fibers is introduced into an optical fiber, for

example, an irradiation optical fiber 8-1 by an optical fiber coupler 7. The two-wavelength light beams from the light modules are introduced into the irradiation optical fibers 8-1 to 8-4, respectively, and irradiated onto four different irradiation  
5 positions on the surface of a body 9 to be inspected out of the other ends of the irradiation optical fibers. Light reflected from the body to be inspected is detected by detecting optical fibers 10-1 to 10-5 arranged at five detecting positions. An end surface of each of the optical fibers is softly in contact  
10 with the surface of the body 9 to be inspected, that is, the optical fiber is attached to the body 9 to be inspected using, for example, a probe described in Japanese Patent Application Laid-Open No.9-149903.

FIG. 24 is a view showing an example of a geographical  
15 arrangement of the irradiation positions 1 to 4 and the detecting positions 1 to 5 on a surface of the body 9 to be inspected. In the present embodiment, the irradiation position and the detecting position are alternatively arranged on a square lattice. Assuming that the middle position between the  
20 irradiation position and the detecting position adjacent to each other is a measured position, number of measured positions, that is, number of measurement channels is 12 because there are 12 combinations of the irradiation position and the detecting position adjacent to each other. The arrangement of the light  
25 irradiation positions and the detecting positions is described, for example, in Japanese Patent Application Laid-Open No.9-149903 and an article entitled "Near-infrared topographic measurement system: Imaging of absorbers localized in a scattering medium" by Yuichi Yamashita et al., Review of

Scientific Instrument, Volume 67, pages 730 - 732. It is reported, for example, in an article entitled "Intracerebral penetration of infrared light" by P.W.McCormic et al., Journal of Neurosurgery, Volume 76, pages 315 - 318 that when the  
 5 interval between the irradiation position and the detecting position adjacent to each other is set to 3 cm, light detected at each of the detecting positions penetrates through the skin and the skull and has information.

From the above, by setting twelve measurement channels  
 10 under the arrangement of the irradiation and the detecting positions, a cerebrum in an area of 6 cm  $\times$  6 cm can be measured as a whole. Although the present embodiment shows the case where the number of measurement channels is 12 in order to simplify the explanation, the measurement area can be easily expanded  
 15 by further increasing numbers of the light irradiation positions and the light detecting positions arranged in a lattice to further increase number of measurement channels.

Referring to FIG. 1, the reflected light detected by each of the detecting optical fibers 10-1 to 10-5 is detected on the  
 20 detecting position basis, that is, detected independently in the detecting optical fiber corresponding to each of the detecting positions using the five light detectors, for example, using the photo-diodes 11-1 to 11-5. The photo-diode is preferably an avalanche photo-diode which can realize high  
 25 sensitive light measurement. Further, a photo-multiplier tube may be used as the light detector. After converting the light signal into an electric signal by the photo-diode, a modulated signal corresponding to both of the irradiation position and the wavelength is selectively detected by the lock-in amplifier

module 12 composed of a plurality of circuits for selectively detecting a modulated signal, for example, a plurality of lock-in amplifiers. Although in the present embodiment the lock-in amplifiers are shown as the modulated signal detecting  
 5 circuits coping with the case of analogue modulation, digital filters or digital processors for detecting the modulated signals are used in a case of using digital modulation.

FIG. 25 is a block diagram showing the construction of lock-in amplifier module of FIG. 1. Initially, explanation will  
 10 be made on modulated signal separation of the detected signal detected by the photo-diode 11-1 at the position 1 in FIG. 24. At the "detecting position 1", the light irradiated at the "light irradiation position 1", at the "light irradiation position 2", at the "light irradiation position 3" and at the  
 15 "light irradiation position 4" adjacent to the detecting position 1 can be detected, and accordingly the "measured position 4", the "measured position 6", the "measured position 7" and the "measured position 9" in FIG. 24 are positions to be measured. Here, the detected signal detected by the  
 20 photo-diode 11-1 at the "position 1" includes eight signal components having the modulation frequencies of  $f(1-a)$ ,  $f(1-b)$ ,  $f(2-a)$ ,  $f(2-b)$ ,  $f(3-a)$ ,  $f(3-b)$ ,  $f(4-a)$  and  $f(4-b)$  corresponding to the two-wavelength light each irradiated onto the "irradiation position 1", the "irradiation position 2", the  
 25 "irradiation position 3" and the "irradiation position 4". The light signals containing the eight signal components are introduced into the eight lock-in amplifiers 13-1 to 13-8 through the 8 amplifiers 14-1 to 14-8. Modulation frequency signals of  $f(1-a)$ ,  $f(1-b)$ ,  $f(2-a)$ ,  $f(2-b)$ ,  $f(3-a)$ ,  $f(3-b)$ ,

f(4-a) and f(4-b) are given to the 8 lock-in amplifiers 13-1 to 13-8 as reference signals, respectively. Therefore, the light signal components of 780 nm and 830 nm wavelengths irradiated onto the "irradiation position 1" are selectively  
5 separated by the lock-in amplifiers 13-1 and 13-2; the light signal components of 780 nm and 830 nm wavelengths irradiated onto the "irradiation position 2" are selectively separated by the lock-in amplifiers 13-3 and 13-4; the light signal components of 780 nm and 830 nm wavelengths irradiated onto the  
10 "irradiation position 3" are selectively separated by the lock-in amplifiers 13-5 and 13-6; and the light signal components of 780 nm and 830 nm wavelengths irradiated onto the "irradiation position 4" are selectively separated by the lock-in amplifiers 13-7 and 13-8.

15 In regard to the detecting signals detected by the photo-diodes 11-2 to 11-5 at the "detecting position 2", at the "detecting position 3", at the "detecting position 4" and at the "detecting position 5", respectively, the desired light signal components are similarly selectively separated to be  
20 lock-in detected. That is, the light signal detected by the photo-diode 11-2 at the "detecting position 2" is introduced into the four lock-in amplifiers 13-9 to 13-12 through the four amplifiers 14-9 to 14-12, and the light components of 780 nm and 830 nm wavelengths irradiated at the "irradiation position  
25 1" and the light components of 780 nm and 830 nm wavelengths irradiated at the "irradiation position 2" each are selectively separated to be lock-in detected; the light signal detected by the photo-diode 11-3 at the "detecting position 3" is introduced into the four lock-in amplifiers 13-13 to 13-16 through the four



amplifiers 14-13 to 14-16, and the light components of 780 nm and 830 nm wavelengths irradiated at the "irradiation position 1" and the light components of 780 nm and 830 nm wavelengths irradiated at the "irradiation position 3" each are selectively separated to be lock-in detected; the light signal detected by the photo-diode 11-4 at the "detecting position 4" is introduced into the four lock-in amplifiers 13-14 to 13-20 through the four amplifiers 14-14 to 14-20, and the light components of 780 nm and 830 nm wavelengths irradiated at the "irradiation position 3" and the light components of 780 nm and 830 nm wavelengths irradiated at the "irradiation position 4" each are selectively separated to be lock-in detected; and the light signal detected by the photo-diode 11-5 at the "detecting position 5" is introduced into the four lock-in amplifiers 13-21 to 13-24 through the four amplifiers 14-21 to 14-24, and the light components of 780 nm and 830 nm wavelengths irradiated at the "irradiation position 2" and the light components of 780 nm and 830 nm wavelengths irradiated at the "irradiation position 4" each are selectively separated to be lock-in detected.

It can be understood from FIG. 24 that in the case where the detecting positions are the "detecting position 2", the detecting position 3", the "detecting position 4" and the "detecting position 5", the positions to be measured are the "measured position 1" and the measured position 3", the measured position 2" and the "measured position 5", the measured position 10", and the "measured position 8" and the "measured position 11".

As described above, in the case where number of the wavelengths is two and number of the measured positions is

twelve, twenty-four of the lock-in amplifiers 13-1 to 13-24 in total are used in the lock-in amplifier module 12. Each of the analogue signals output from the lock-in amplifiers 13-1 to 13-24 (channel 1 to 24) is accumulated for a preset time by a  
 5 sample hold circuit of the channel corresponding to the sample hold circuit module 16. After completion of the accumulation, the switch (multiplexer) 17 is sequentially switched to convert the signal accumulated in each of the sample hold circuits to a digital signal, for example, by a 12-bit analogue/digital  
 10 converter (A/D converter) 18, and the converted signals in all of the channels are stored in a memory unit outside a computer 19. Of course, the converted signals may be stored in a memory unit inside the computer 19.

The channel number corresponds to the address of the memory unit  
 15 with a one to one relation

In a case of not using the sample hold circuit module 16, the switch 17 is repetitively switched at high speed. The analogue signal of each channel is converted into a digital signal using the analogue/digital converter 18 every switching  
 20 to be accumulated in the memory unit 20, and the digital signals acquired a preset number of times are averaged on the channel basis to be stored in the memory unit 20. This method can reduce noise of high frequency components.

Based on the data stored in the computer 19, change in  
 25 the concentration of oxygenated hemoglobin and change in the concentration of deoxygenated hemoglobin associated with cerebral activity, and further change in the concentration of total hemoglobin as the total concentration of hemoglobin are calculated through the method described in, for example,

Japanese Patent Application Laid-Open No.9-19408 and in an article entitled "Spatial and temporal analysis of human moter activity using noninverse NIR topography" by Atsushi Maki et al., Medical Physics, Volume 22, pages 1997 - 2005 (1995), and the result such as a topography image or the like is displayed on the display portion 20.

Referring to FIG. 1, the computer 19 may be a personal computer. An operating portion 22 is connected to the computer 19, and the operating portion includes a keyboard, a mouse and so on for inputting and outputting various kinds of information and for adding and deleting data. FIG. 26 is a graph showing time variation of a measured signal 30 at a detecting position and of a predicted no-load signal 31 obtained from the measured signal. The graph is displayed on the display portion 21, and the abscissa indicates measurement time and the ordinate indicates an amount of relative change in hemoglobin concentration, that is, the amount corresponding to change in hemoglobin concentration at a specific position in a cerebrum caused by motion of a specific position of a body (for example, motion of a part of the body such as a finger or the like). The predicted no-load signal 31 is obtained from the measured signal 30 by fitting an arbitrary function to the measured signal 31 in the time before loading T1 and the time after applying load T3 except the signals in the time applying load (loading time) Tt and the time until the signal returns the original value (relaxation time) T2 through the least-squares method. In the present embodiment, the processing is performed by using a secondary-order linear polynomial for the arbitrary function and by setting T1 = 40 seconds, T2 = 30 seconds and T3 = 30

seconds.

FIG. 27 shows an example of time variations of an amount of relative change in concentrations of oxygenated hemoglobin and an amount of relative change in concentrations of deoxygenated hemoglobin at a measurement position. The graph is displayed on the display portion 21. The abscissa indicates measurement time and the ordinate indicates relative amounts of change in the concentrations. The time illustrated by the hatched area is a load applying time (a period of moving a finger of right hand). In regard to the relative amount of change shown in FIG. 26, the relative amounts of changes in oxygenated hemoglobin and in deoxygenated hemoglobin ( $H_bO_2$ ,  $H_b$ ) associated with load application is calculated based on the non-load signal 31 and the predicted non-load signal 32 through a predetermined calculation processing.

Each of FIG. 28 and FIG. 29 shows a contour image (a topography image) produced from the time variation of the relative amount of change in a concentration of oxygenated hemoglobin at each measurement position displayed in the display portion 21 when motion of left-hand or right-hand fingers of a person to be inspected is used as load, respectively. The topography image is formed by calculating an integrated value with time (an averaged value with time may be acceptable) of the signal of relative amount of change 32 in the load applying time (the hatched period in FIG. 27) by the processing portion 19, and linearly interpolating between the measured positions in the X-axis direction and the Y-axis direction. As the topography image, a monochrome gray-scale image or a color identifying image may be acceptable instead of the contour image

shown in FIG. 28 and FIG. 29. It can be understood from FIG. 28 and FIG. 29 that the oxygenated hemoglobin concentration is clearly increased at a specific position when right-hand finger is moved.

5 By displaying such information of spatial distribution as an image, recognition of the measured result can be made speedy and easy. Further, although the images shown in FIG. 28 and FIG. 29 are formed using the time-integrated values of the relative amount of change in concentration during the load apply  
10 time period, a similar topography image can be formed using relative amounts of change in oxygenated hemoglobin concentration at the measured positions every measuring time performed at a time. By displaying the plurality of formed topography images in order of measured time or as a moving  
15 picture, the time variation of the relative amount of change in the oxygenated hemoglobin concentration can be understood.

Further, by calculating a self-correlation function of the time variation of the relative amount of change in oxygenated hemoglobin concentration at an arbitrary one  
20 measured position and a mutual-correlation function of the time variation of the relative amount of change in oxygenated hemoglobin concentration at one and the other measured positions, a topography image for each position can be also formed from the correlation functions. Since the correlation  
25 function at each position is a function defined by shifting time by  $\tau$ , a state of propagation of change in a dynamic blood state can be visualized by forming photography images from the values of the correlation functions shifting by the same time of  $\tau$  and displaying the photography images in order of  $\tau$  or as a moving

picture. Although the description here is made on the relative amount of change in oxygenated hemoglobin concentration as the typical example, the relative amount of change in deoxygenated hemoglobin concentration and the relative amount of change in the total hemoglobin concentration calculated as the sum of the relative amounts of change in oxygenated and deoxygenated hemoglobin concentrations can be similarly formed in the topography images.

FIG. 30 shows an example of a display superposing a topography image 34 formed through the method described above on a cerebrum surface image 35 of a person to be inspected. Since the topography image 34 is change in a dynamic blood state of a cerebrum changing in association with change in a biological function, it is preferable that the topography image is displayed by superposing on the cerebrum surface image. The cerebrum surface image 35 is displayed by being measured by a three-dimensional MRI or a three-dimensional X-ray CT. The topography image 34 is a topography image which is formed by converting the coordinate system so that the coordinates of the measured positions are placed on the surface of the cerebrum, and then interpolating the values between the measured positions. When the formed topography image 34 is displayed by superposing on the cerebral surface image 35, the color of the superposed topography image 34 is made translucent so that the cerebral surface image under the topography image 34 can be seen.

FIG. 2 is a flowchart showing an example of processing flow in accordance with the present invention for measuring a body to be inspected using the optical measurement system shown

in FIG. 1. Operation of the optical measurement system is sequentially performed while an operator is looking at the windows, shown in FIG. 3 to FIG. 22, displayed on a window display screen of the display portion 21.

5       As the operating system of the system is booted, an initial window for selecting main menu shown in FIG. 3 is displayed (S1). Referring to FIG. 3, the processing proceeds to measurement processing when the button 301 is selected, the processing proceeds to data analysis when the button 302 is  
10   selected and the program is ended when the button 303 is selected.

Assuming now that the button 301 is selected, the initial window shown in FIG. 3 disappears, and the processing proceeds to the measurement processing to display a window for inputting  
15   conditions shown in Fig. 4 is displayed in the middle of the display screen of the display portion 21 (S2). In regard to FIG. 4, meaning and function of each part are as follows.

401: A bar for inputting a title. In detail, a name of inspection to be performed is input.

20       402: A part for displaying data and time, data and time as displaying the window is displayed by default (automatically displayed numerals or characters).

403: A part for inputting a kind of stimulation (for example, finger motion, writing, speaking, giving medication  
25   and so on). A list display button (an inverted delta symbol button) is pushed and then desired items are selected from pre-registered kinds in the list box. The selected kinds are displayed by changing the back color or with reversed characters. The data can be added, deleted and replaced.

404: A kind of item selected in the stimulation input part can be deleted by this button.

405: A part for selecting a measurement mode. The measurement mode is determined by number of measuring channels and number of surfaces to be measured. For example, in a case where number of measurement channels is 1 and number of surfaces to be measured is 2, it is assumed that measurement mode 1 is selected.

406: A part for freely writing memorandum.

10 407: A part for inputting name of a person to be inspected.

408: A part for inputting age of a person to be inspected.

409: A part for inputting sex of a person to be inspected.

410: A part for inputting a kind of a person to be inspected, that is, a patient or a healthy parson.

15 411: A setting ending button.

412: A button for returning to the initial window.

After inputting and setting the above conditions, by pushing the button 412, the window for inputting conditions disappears and a window for displaying gain adjusting underway shown in FIG. 5 is displayed in the middle of the screen (S3). This expresses that the measurement system is under automatic gain adjusting, and after completion of the adjustment the window for displaying gain adjusting underway disappears and a window for displaying measured positions is displayed in the middle of the display screen (S4). Essentially after now, this window is always displayed at a position in the screen of the display portion 21. By always displaying the window for displaying measured positions, it is possible to easily and speedily understand the correspondence between the many



measured signals and the actual measured positions. There, the irradiation optical fibers 8-1 to 8-4 and the detecting optical fibers 10-1 to 10-5 shown in FIG. 1 are generally fixed in a helmet to be put on by the person to be inspected. Therefore, if measuring channel numbers are indicated on the helmet to make the positional relationship between the number shown by the reference character 602 in FIG. 6, recognition of the operator is further assisted.

Referring to FIG. 6, the reference character 601 is a part for displaying the selected measuring mode, the displayed window for displaying measured positions corresponds to the measuring mode. The reference character 602 is a part for displaying number of measuring channels of the measured plane. The reference character 603 indicates the setting positions of the irradiation and the detecting optical fibers, that is, the irradiation positions and the detecting positions. The reference character 604 indicates the measuring channel numbers, and the measuring channel number is displayed in green color when the automatic gain adjustment of the measuring channel is well performed.

When there exists at least one measuring channel which is failed in the gain adjustment, the measuring channel number of the measuring channel is displayed in red color. Further, in this case, a window for display abnormality shown in FIG. 7 is displayed near the window for displaying measured positions shown in Fig. 6 (S5). The case where the gain adjustment is failed means that there is possibly a problem in a measured position in the right-hand side or the left-hand side or the upper side or the down side of the channel displayed in red color.

Since it is considered that there is a problem in setting of the optical fiber when the red-colored display appears, the optical fiber is required to be reset. Therefore, after resetting the optical fiber, the reference character 701 in FIG. 7 is used when the measurement is aborted by returning to the window of FIG. 3 or FIG. 4. When the button 702 of FIG. 7 is pushed, the window for display abnormality is deleted and the window for displaying gain adjusting underway is displayed to perform the automatic gain adjustment again. When there remains still any abnormality after adjusting gain, the window for displaying gain adjusting underway shown in FIG. 5 is deleted, and the abnormal measuring channel in the window for displaying measured positions shown in FIG. 6 is displayed in red color, and the window for displaying abnormality shown in FIG. 7 is displayed near the window for displaying measured positions shown in FIG. 6. When no abnormality occurs, the window for displaying gain adjusting underway shown in FIG. 5 is deleted, and all the measuring channels in the window for displaying measured positions shown in FIG. 6 are changed to green color, and a window for forming a file shown in FIG. 8 is displayed.

In FIG. 7, the reference character 703 is a button which is pushed when the abnormality is neglected. When the button is pushed, the window for forming a file is displayed (S6) by neglecting the abnormal measuring channel in the window for displaying measured positions shown in FIG. 6 (remaining the red colored display as it is). The window for forming a file shown in FIG. 8 is displayed in the middle of the display screen regardless of presence and absence of abnormality, and the position of the window for displaying measured positions shown

in FIG. 6 is moved to a lower left position in the display screen as the window for forming a file shown in FIG. 8 is displayed. By this display method, the operator can always watch the condition to be input.

5 In FIG. 8, meaning and function of each part are as follows.

801: A part for inputting a file name.

802: A part for displaying a list of all files existing in a hierarchy which is selected by the button 804. For example,  
10 data names of measurement previously performed are displayed in this part.

803: A part for displaying the present path.

804: A part for displaying a directory list (hierarchy list).

15 805: A button for giving permission to proceed to measurement process.

806: A pushed button for canceling and returning to the window for inputting conditions of FIG. 4. When the button is pushed, the window for forming a file shown in FIG. 8 and the  
20 window for displaying measured positions shown in FIG. 6 are deleted, and the window for inputting conditions shown in FIG. 4 is displayed.

807: A button for displaying the window for creating directory, and the button is used when creating a new directory.  
25 When the button is pushed, the window for creating directory is displayed superposing on the window for forming a file shown in FIG. 8 in a slightly shifting state. At that time, the window for creating directory shown in FIG. 9 can not be operated.

808: A button for performing specifying a drive.

When the button 807 is pushed, the window for creating directory shown in FIG. 9 is displayed (S7). Referring to FIG. 9, the reference character 901 is a part for inputting name of a directory to be created, the reference character 902 is a button for completing directory creation, and the reference character 903 is a cancel button. When any one of the buttons is pushed, the window for creating directory shown in Fig. 9 is deleted and the processing is returned to the window for forming a file shown in FIG. 8.

Referring to FIG. 8, when the button 805 is pushed, the window for forming a file shown in FIG. 8 is deleted, and a measurement window shown in FIG. 10 is displayed an upper left portion of the display screen (S8), and a window or windows for displaying measurement data time sequence shown in FIG. 14 is or are displayed in a large portion in the right side of the display screen (S11). FIG. 8 is used for controlling execution of measurement. In regard to FIG. 10, meaning and function of each part are as follows.

1001: A button for selecting Info. When Info is selected, a window for selecting Condition or Tuneup as a sub-menu, as shown in FIG. 11. When Condition in sub-menu of FIG. 11 is selected, the window for inputting condition similar to FIG. 4 is displayed (S9). This is for checking the present status or inputting an additional condition. When Tuneup in the sub-menu of FIG. 11 is selected, a window for inputting measuring condition and display condition shown in FIG. 12 is displayed (S12). When the cancel button is pushed in the step 9 or step 10, the window for inputting condition similar to FIG. 4 or the window for inputting measuring condition and display

condition shown in FIG. 12 is deleted, and the processing is returned to the measurement window of FIG. 10.

1002: When Option is selected by the button for selecting Option, A sub-menu window shown in FIG. 13 is displayed. Here,  
 5 graph display conditions for measurement underway, and conditions of a data backup interval and signals output from the other measurement instruments to be described later are input, but there is no need to input every time because there is a learning function to automatically reflecting values which  
 10 are set at the preceding measurement.

1003: A part for specifying and displaying a data acquisition time interval.

1004: A part for displaying number of data acquisition times (number of sampling times).

15 1005: A part for displaying a measuring elapsing time.

1006: A part for displaying the next measurement state.

Run : measuring underway

Completion : normal completion of measurement

20 Overrun : abnormal completion of measurement due to overflow of A/D converter

Stop : abnormal completion of measurement due to the other cause

File error : error in measurement file writing

Backup file error : error in backup file writing

25 1007: A button for starting measurement. When the button is pushed, measurement is started and measurement data time sequence signal graph is displayed in each axis in FIG. 14 (S11). The displayed graph expresses a change ratio.

1008: A button for completing data acquisition.

1009: A button for completing measurement and inspection.

1010: A part for displaying an elapsing time after pushing Mark button 1011. By this part, there is an advantage in that a stimulating time period can be managed without using any  
5 stopwatch.

1011: The Mark button which is for inserting a mark of a vertical line in the graph of FIG. 14 during measurement. This mark is usually input at starting and at completing stimulation as a reference for data analysis, but the mark may be arbitrarily  
10 input when an event requiring to record time occurs during measurement. When a mark input signal is supplied from an external device, a mark is displayed in the drawing of figure 14 without pushing the button. Moreover, a sound may be generated When the mark input signal is supplied.

15 In the window for inputting measuring condition and display condition shown in FIG. 12, a measurement condition corresponding to a selected measurement mode is displayed. The measurement condition expresses correspondence to a measuring channel (measuring position), a channel of A/D converter, a  
20 wavelength, a signal amplification and so on. Further, specifying of a channel to measure and specifying a channel to display may be possible. Furthermore, it is possible to instruct to input another signal into a vacant channel. In regard to FIG. 12, meaning and function of each part are as follows.

25 1201: There are tables showing the measurement conditions and the display conditions for each wavelength using in the selected mode, and a table in regard to a wavelength to be displayed is selected using this tab.

1202: A part for specifying requirement of displaying a

graph to display the graph. The word True in the column means displaying the graph, and the word False means not displaying the graph. By pre-selecting graphs not required to be display for individual channels (by clicking a box in the Visible column, 5 the selection is performed to change the back color or to be inversely displayed), and then by specifying a False button of 1212, the selected measurement channel is turned from True to False.

1203: A part for displaying a gain of the lock-in  
10 amplifier.

1204: A part for displaying a dynamic range of the A/D converter. In the columns of the parts 1203 and 1204, the values determined by the automatic gain adjustment are displayed.

1205: A part for displaying wavelength.

15 1206: A part for displaying a kind of signal. The word Optical means optical measurement. For example, in a case where a brain wave signal is measured at a time using an additional channel (the addition can be specified in the part 1208), the operator inputs EEG. The signals other than Optical can be 20 separately processed during data analysis.

1207: A part for displaying a channel number of measurement.

1208: A part for specifying and displaying effectiveness (True) and ineffectiveness (False) of the channel number of the 25 A/D converter. The specifying method is similar to the case of the part 1202. When False is selected in a channel, measurement in the specified channel is not performed.

1209: A window for inputting a character string or a number string in a position selected in the parts 1202 to 1208.

1210: A part for changing the dynamic range of the A/D converter. It become effective when the part 1204 is selected.

1211: A part for changing a gain of the lock-in amplifier. It become effective when the part 1203 is selected.

5       1212: A part for switching True and False in the columns 1202 and 1208.

1213: A part for selecting a displayed measurement mode. The word Each means that displayed tables are displayed by a plurality of tables for each wavelength, and the word All means  
10       that all the measuring channels are displayed by one table.

1214: A button for completing setting.

1215: A button for canceling setting.

According to the window of FIG. 12, checking and setting change can be easily performed because the monitor of the  
15       measurement conditions (1203 to 1208) and the conditions of graph display (1202) are shown on the single window. Further, a signal of another measurement instrument (apparatus) can be acquired using this window. Furthermore, the window of FIG. 12 is only one window that the operator inputs used conditions by  
20       selecting necessity of measuring input signals.

In a sub-menu window of Option in the measurement window of FIG. 10, the following windows is displayed depending on which is selected. However, displays of Trigger Pulse and External Trigger to be selected are omitted in FIG. 13.

25       Graph       : A window for inputting the display conditions of graph of FIG. 14 (FIG. 15)

Backup       : A window for inputting a file backup condition (FIG. 16)

Other CH     : A window for input setting of the other



measurement equipment output signal (FIG. 17)

Trigger Pulse : A window for setting a rectangular wave output signal (FIG. 18)

External Trigger : A window for setting an external input  
5 trigger synchronous measurement condition (FIG. 20)

Measurement Parameter : A window for setting a measured data acquiring condition (FIG. 21)

Prescan : A window for checking a measured signal (FIG.  
22)

10 Position : A window for displaying measured positions (FIG. 6) (returning to the step S6)

In regard to FIG. 15 to 18 and 20 to 22, meaning and function of each part are as follows.

FIG. 15 (the window for inputting the display conditions  
15 of graph of FIG. 14) (S12)

1) A range of the X-axis is input. In order to input the range, there are two input methods, that is, one is a method of inputting a magnification performed in 1501, and the other is a method of inputting a displayed time performed in 1503.

20 1501: A button for selecting a display magnification inputting of the X-axis of graph.

1502: A part for inputting a display magnification of the X-axis of graph by a percentage. For example, in a case where the time period of 3600 seconds is displayed when the  
25 magnification is 100 %, the displayed time period becomes within a range of 360 seconds if the magnification is changed to 1000 %. In this case, when the time exceeds 360 seconds, the window is scrolled to the left-hand side. In detail, assuming data of 362 seconds is acquired, the displayed range of the X-axis of the

graph of FIG. 14 is from 2 seconds to 362 seconds.

1503: A button for selecting the displayed time inputting of the X-axis of the graph. When this button is selected, the button 1501 is automatically changed to not selected. The button  
5 1501 and the button are mutually exclusive.

1504: A part for inputting a displayed time period of the X-axis of the graph.

1505: A part for displaying number of data kinds acquired within a displayed time period specified in the part 1504.

10 2) A range of the Y-axis is input.

1506: A part for selecting a display magnification inputting of the Y-axis of graph. The way of thinking is similar to that of the case of selecting a display magnification inputting of the X-axis of graph.

15 3) The format of graph display of FIG. 14 is selected.

1507: A button for selecting displaying all the channels (all the channels selected to display in FIG. 12) in order of the measured channel. When this button is selected, the windows shown in FIG. 14, number of which is equal to number of the  
20 wavelengths used in each measurement channel in number (two wavelengths in this embodiment), are displayed so as to overlap with each other. In that case, the first window shows signals of the first wavelength in order of the measured channel, and the second window shows signals of the second wavelength in  
25 order of the measured channel. If the setting is particularly not made, Together is selected.

1509: A button for displaying all the channels within a single window.

1509: A button for separately displaying within a window

for each channel. Further, there are two kinds of display methods as follows.

Title: Graphs are displayed by arranging in a matrix-shape.

5 Cascade: Graphs are displayed by superposing on another.

1510: A button for displaying only one specified channel (the channel displayed in FIG. 12 can be selected).

1511: A part for forcing not displaying the graphs.

1512: A part for completing the setting. By completing  
10 the setting, the window display is returned to the window display of FIG. 10.

1513: A part for canceling. In the case of canceling, the window display is also returned to the window display of FIG. 10.

15 FIG. 16 (the window for inputting a file backup condition) (S13)

This window is for setting the condition of function of backup data during measurement at any time by assuming a case of a power outage during measuring or a case where a file  
20 specified by the window for forming a file of FIG. 8 is damaged due to some causes.

1601: A part for specifying whether or not backup is necessary.

1602: A part for inputting a backup time interval.

25 1603: A part for inputting a backup file name by full-pass.

1604: A part for referring to a directory and a file. The window for forming a file of FIG. 8 is displayed, and the specified file name is entered to Backup File Name area.

1605: A button for completing the setting. By completing the setting, the window display is returned to the window display of FIG. 10.

1606: A button for canceling. In the case of canceling, the window display is also returned to the window display of FIG. 10.

FIG. 17 (The window for input setting of the other measurement equipment output signal) (S14)

By this window, a signal output from another measurement instrument is acquired from data of a vacant A/D converter channel. A channel number of the A/D converter used at acquiring the data, a name of kind of the signal (EEG and so on) and a dynamic range of the A/D converter are selected.

1701: A part for displaying a channel number of a vacant A/D converter used for inputting. The vacant A/D converter having a least channel number is automatically allocated.

1702: A part for inputting a kind name of signal.

1703: A part for selecting a dynamic range of an A/D converter of another input.

1704: A button for completing the setting. By completing the setting, the window display is returned to the window display of FIG. 10.

1705: A button for canceling. In the case of canceling, the window display is also returned to the window display of FIG. 10.

FIG.18 (The window for setting a rectangular wave output signal (S15))

A rectangular wave voltage signal is periodically output from the present optical measurement system. By inputting this

signal into the other measurement instruments (a brain wave meter and so on), the measuring time can be strictly set in agreement between the instruments. The rectangular wave signal is output from, for example, a serial board of a personal  
 5 computer.

There are three kinds of the output rectangular wave signals, as shown in FIG. 19. The first kind is a rectangular wave signal which is output only at starting of measurement. The second kind is a rectangular wave signal which is  
 10 periodically output until the measurement is completed. The third kind is a rectangular wave signal which is output in synchronism with pushing of the mark button of FIG. 10. The condition of these three kinds of rectangular wave signals can be set by the window of FIG. 18.

15 1801: A part for selecting whether or not the rectangular wave output is necessary.

1802: A part for selecting a terminal to output the rectangular wave signal.

20 1803: A part for inputting a time width of the first kind of rectangular wave signal (refer to A of FIG. 19).

1804: A part for inputting number of repetitive times of the first kind of rectangular wave signal (refer to B of FIG. 19).

25 1805: A part for inputting number of repetitive times of the second kind of rectangular wave signal (refer to C of FIG. 19).

1806: A part for inputting a time width of the second kind of rectangular wave signal (refer to D of FIG. 19).

1807: A part for inputting a time width of the third kind

of rectangular wave signal (refer to E of FIG. 19).

1808: A button for completing the setting. By completing the setting, the window display is returned to the window display of FIG. 10.

5        1809: A button for canceling. In the case of canceling, the window display is also returned to the window display of FIG. 10.

FIG. 20 (The window for setting an external input trigger synchronous measurement condition) (S16)

10        This window is a window which is used when measurement is performed in synchronism with a trigger signal from the external. By performing synchronous measurement, the time is completely in synchronism with the other measurement instrument and a stimulation apparatus.

15        2001: A part for specifying whether or not the external input trigger synchronous measurement is necessary.

2002: A part for inputting a channel number of the A/D converter used for the external input trigger signal.

2003: A part for inputting a measuring time to each  
20 trigger signal.

2004: A part for inputting a threshold value of a voltage value which is recognized as the trigger signal.

2005: A button for completing the setting. By completing the setting, the window display is returned to the window  
25 display of FIG. 10.

2006: A button for canceling. In the case of canceling, the window display is also returned to the window display of FIG. 10.

FIG. 21 (the window for setting a measured data acquiring

condition) (S17)

By this window, a channel operating frequency of the A/D converter (Burst Rate), a sampling frequency per one channel of the A/D converter (Conversion Rate), an average number of adding  
 5 times of acquired data (number of Samples), an adding time of acquired data (Acquisition Time), a data acquisition time interval (Sampling Period: the same as the part 1003 of FIG. 10) and a total measuring time can be set.

2101: A part for displaying and inputting Burst Rate.

10 2102: A part for displaying and inputting Conversion Rate.

2103: A part for displaying and inputting number of samples acquiring one sampling.

2104: A part for displaying a data acquisition time.

15 2105: A part for displaying and inputting a data acquisition time interval.

2106: A part for displaying and inputting a measurement time.

2107: A button for completing the setting. By completing  
 20 the setting, the window display is returned to the window display of FIG. 10.

2108: A button for canceling. In the case of canceling, the window display is also returned to the window display of FIG. 10.

25 FIG. 22 (The window for checking a measured signal) (S18)

This window is used for that the operator checks the state of signals by performing pre-measurement in prior to starting the actual measurement, if necessary. A value of signal displayed in the graph is expressed by a voltage value.

2201: A part for displaying a data acquisition time interval.

2202: A part for displaying number of data acquisition times (number of sampling times).

5 2203: A part for displaying a measuring elapsing time.

2204: A part for displaying a measuring state (refer to FIG. 10).

2205: A part for specifying a magnification of the X-axis of the graph (refer to FIG. 15).

10 2206: A part for displaying the result of pre-measurement by numerical values for each channel.

2207: A button for starting of checking output signals. When this button is pushed, the measured signals are displayed in a single window or a plurality of windows shown in FIG. 14  
15 corresponding to the form of the graph set by the window shown in FIG. 15.

2208: A button for aborting measurement.

2209: A button for completing the pre-measurement. By pushing this button, the display window is returned to the  
20 display window of FIG. 10.

By the embodiment described above, an operator, even if not skilled, can perform input work speedily and without error. Further, there are provided the option functions which can be set by an operator.

25 According to the present invention, it is possible to provide an optical measurement system and an optical measurement method which is suitable for optically measuring a body to be inspected and easily obtaining an image of a desired item based on information obtained by the measurement.



Further, according to the present invention, an operator, even if not skilled, can perform input work speedily and without error. Accordingly, the operator can perform the optical measurement operation even if he is not understand the operating  
5 manual very well.

Furthermore, according to the present invention, it is possible to understand a state of change in a body to be inspected, for example, an activation state of cerebral oxygen metabolism with high accuracy.

11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100  
101  
102  
103  
104  
105  
106  
107  
108  
109  
110  
111  
112  
113  
114  
115  
116  
117  
118  
119  
120  
121  
122  
123  
124  
125  
126  
127  
128  
129  
130  
131  
132  
133  
134  
135  
136  
137  
138  
139  
140  
141  
142  
143  
144  
145  
146  
147  
148  
149  
150  
151  
152  
153  
154  
155  
156  
157  
158  
159  
160  
161  
162  
163  
164  
165  
166  
167  
168  
169  
170  
171  
172  
173  
174  
175  
176  
177  
178  
179  
180  
181  
182  
183  
184  
185  
186  
187  
188  
189  
190  
191  
192  
193  
194  
195  
196  
197  
198  
199  
200  
201  
202  
203  
204  
205  
206  
207  
208  
209  
210  
211  
212  
213  
214  
215  
216  
217  
218  
219  
220  
221  
222  
223  
224  
225  
226  
227  
228  
229  
230  
231  
232  
233  
234  
235  
236  
237  
238  
239  
240  
241  
242  
243  
244  
245  
246  
247  
248  
249  
250  
251  
252  
253  
254  
255  
256  
257  
258  
259  
260  
261  
262  
263  
264  
265  
266  
267  
268  
269  
270  
271  
272  
273  
274  
275  
276  
277  
278  
279  
280  
281  
282  
283  
284  
285  
286  
287  
288  
289  
290  
291  
292  
293  
294  
295  
296  
297  
298  
299  
300  
301  
302  
303  
304  
305  
306  
307  
308  
309  
310  
311  
312  
313  
314  
315  
316  
317  
318  
319  
320  
321  
322  
323  
324  
325  
326  
327  
328  
329  
330  
331  
332  
333  
334  
335  
336  
337  
338  
339  
340  
341  
342  
343  
344  
345  
346  
347  
348  
349  
350  
351  
352  
353  
354  
355  
356  
357  
358  
359  
360  
361  
362  
363  
364  
365  
366  
367  
368  
369  
370  
371  
372  
373  
374  
375  
376  
377  
378  
379  
380  
381  
382  
383  
384  
385  
386  
387  
388  
389  
390  
391  
392  
393  
394  
395  
396  
397  
398  
399  
400  
401  
402  
403  
404  
405  
406  
407  
408  
409  
410  
411  
412  
413  
414  
415  
416  
417  
418  
419  
420  
421  
422  
423  
424  
425  
426  
427  
428  
429  
430  
431  
432  
433  
434  
435  
436  
437  
438  
439  
440  
441  
442  
443  
444  
445  
446  
447  
448  
449  
450  
451  
452  
453  
454  
455  
456  
457  
458  
459  
460  
461  
462  
463  
464  
465  
466  
467  
468  
469  
470  
471  
472  
473  
474  
475  
476  
477  
478  
479  
480  
481  
482  
483  
484  
485  
486  
487  
488  
489  
490  
491  
492  
493  
494  
495  
496  
497  
498  
499  
500  
501  
502  
503  
504  
505  
506  
507  
508  
509  
510  
511  
512  
513  
514  
515  
516  
517  
518  
519  
520  
521  
522  
523  
524  
525  
526  
527  
528  
529  
530  
531  
532  
533  
534  
535  
536  
537  
538  
539  
540  
541  
542  
543  
544  
545  
546  
547  
548  
549  
550  
551  
552  
553  
554  
555  
556  
557  
558  
559  
560  
561  
562  
563  
564  
565  
566  
567  
568  
569  
570  
571  
572  
573  
574  
575  
576  
577  
578  
579  
580  
581  
582  
583  
584  
585  
586  
587  
588  
589  
590  
591  
592  
593  
594  
595  
596  
597  
598  
599  
600  
601  
602  
603  
604  
605  
606  
607  
608  
609  
610  
611  
612  
613  
614  
615  
616  
617  
618  
619  
620  
621  
622  
623  
624  
625  
626  
627  
628  
629  
630  
631  
632  
633  
634  
635  
636  
637  
638  
639  
640  
641  
642  
643  
644  
645  
646  
647  
648  
649  
650  
651  
652  
653  
654  
655  
656  
657  
658  
659  
660  
661  
662  
663  
664  
665  
666  
667  
668  
669  
670  
671  
672  
673  
674  
675  
676  
677  
678  
679  
680  
681  
682  
683  
684  
685  
686  
687  
688  
689  
690  
691  
692  
693  
694  
695  
696  
697  
698  
699  
700  
701  
702  
703  
704  
705  
706  
707  
708  
709  
710  
711  
712  
713  
714  
715  
716  
717  
718  
719  
720  
721  
722  
723  
724  
725  
726  
727  
728  
729  
730  
731  
732  
733  
734  
735  
736  
737  
738  
739  
740  
741  
742  
743  
744  
745  
746  
747  
748  
749  
750  
751  
752  
753  
754  
755  
756  
757  
758  
759  
760  
761  
762  
763  
764  
765  
766  
767  
768  
769  
770  
771  
772  
773  
774  
775  
776  
777  
778  
779  
780  
781  
782  
783  
784  
785  
786  
787  
788  
789  
790  
791  
792  
793  
794  
795  
796  
797  
798  
799  
800  
801  
802  
803  
804  
805  
806  
807  
808  
809  
810  
811  
812  
813  
814  
815  
816  
817  
818  
819  
820  
821  
822  
823  
824  
825  
826  
827  
828  
829  
830  
831  
832  
833  
834  
835  
836  
837  
838  
839  
840  
841  
842  
843  
844  
845  
846  
847  
848  
849  
850  
851  
852  
853  
854  
855  
856  
857  
858  
859  
860  
861  
862  
863  
864  
865  
866  
867  
868  
869  
870  
871  
872  
873  
874  
875  
876  
877  
878  
879  
880  
881  
882  
883  
884  
885  
886  
887  
888  
889  
890  
891  
892  
893  
894  
895  
896  
897  
898  
899  
900  
901  
902  
903  
904  
905  
906  
907  
908  
909  
910  
911  
912  
913  
914  
915  
916  
917  
918  
919  
920  
921  
922  
923  
924  
925  
926  
927  
928  
929  
930  
931  
932  
933  
934  
935  
936  
937  
938  
939  
940  
941  
942  
943  
944  
945  
946  
947  
948  
949  
950  
951  
952  
953  
954  
955  
956  
957  
958  
959  
960  
961  
962  
963  
964  
965  
966  
967  
968  
969  
970  
971  
972  
973  
974  
975  
976  
977  
978  
979  
980  
981  
982  
983  
984  
985  
986  
987  
988  
989  
990  
991  
992  
993  
994  
995  
996  
997  
998  
999  
1000  
1001  
1002  
1003  
1004  
1005  
1006  
1007  
1008  
1009  
1010  
1011  
1012  
1013  
1014  
1015  
1016  
1017  
1018  
1019  
1020  
1021  
1022  
1023  
1024  
1025  
1026  
1027  
1028  
1029  
1030  
1031  
1032  
1033  
1034  
1035  
1036  
1037  
1038  
1039  
1040  
1041  
1042  
1043  
1044  
1045  
1046  
1047  
1048  
1049  
1050  
1051  
1052  
1053  
1054  
1055  
1056  
1057  
1058  
1059  
1060  
1061  
1062  
1063  
1064  
1065  
1066  
1067  
1068  
1069  
1070  
1071  
1072  
1073  
1074  
1075  
1076  
1077  
1078  
1079  
1080  
1081  
1082  
1083  
1084  
1085  
1086  
1087  
1088  
1089  
1090  
1091  
1092  
1093  
1094  
1095  
1096  
1097  
1098  
1099  
1100  
1101  
1102  
1103  
1104  
1105  
1106  
1107  
1108  
1109  
1110  
1111  
1112  
1113  
1114  
1115  
1116  
1117  
1118  
1119  
1120  
1121  
1122  
1123  
1124  
1125  
1126  
1127  
1128  
1129  
1130  
1131  
1132  
1133  
1134  
1135  
1136  
1137  
1138  
1139  
1140  
1141  
1142  
1143  
1144  
1145  
1146  
1147  
1148  
1149  
1150  
1151  
1152  
1153  
1154  
1155  
1156  
1157  
1158  
1159  
1160  
1161  
1162  
1163  
1164  
1165  
1166  
1167  
1168  
1169  
1170  
1171  
1172  
1173  
1174  
1175  
1176  
1177  
1178  
1179  
1180  
1181  
1182  
1183  
1184  
1185  
1186  
1187  
1188  
1189  
1190  
1191  
1192  
1193  
1194  
1195  
1196  
1197  
1198  
1199  
1200  
1201  
1202  
1203  
1204  
1205  
1206  
1207  
1208  
1209  
1210  
1211  
1212  
1213  
1214  
1215  
1216  
1217  
1218  
1219  
1220  
1221  
1222  
1223  
1224  
1225  
1226  
1227  
1228  
1229  
1230  
1231  
1232  
1233  
1234  
1235  
1236  
1237  
1238  
1239  
1240  
1241  
1242  
1243  
1244  
1245  
1246  
1247  
1248  
1249  
1250  
1251  
1252  
1253  
1254  
1255  
1256  
1257  
1258  
1259  
1260  
1261  
1262  
1263  
1264  
1265  
1266  
1267  
1268  
1269  
1270  
1271  
1272  
1273  
1274  
1275  
1276  
1277  
1278  
1279  
1280  
1281  
1282  
1283  
1284  
1285  
1286  
1287  
1288  
1289  
1290  
1291  
1292  
1293  
1294  
1295  
1296  
1297  
1298  
1299  
1300  
1301  
1302  
1303  
1304  
1305  
1306  
1307  
1308  
1309  
1310  
1311  
1312  
1313  
1314  
1315  
1316  
1317  
1318  
1319  
1320  
1321  
1322  
1323  
1324  
1325  
1326  
1327  
1328  
1329  
1330  
1331  
1332  
1333  
1334  
1335  
1336  
1337  
1338  
1339  
1340  
1341  
1342  
1343  
1344  
1345  
1346  
1347  
1348  
1349  
1350  
1351  
1352  
1353  
1354  
1355  
1356  
1357  
1358  
1359  
1360  
1361  
1362  
1363  
1364  
1365  
1366  
1367  
1368  
1369  
1370  
1371  
1372  
1373  
1374  
1375  
1376  
1377  
1378  
1379  
1380  
1381  
1382  
1383  
1384  
1385  
1386  
1387  
1388  
1389  
1390  
1391  
1392  
1393  
1394  
1395  
1396  
1397  
1398  
1399  
1400  
1401  
1402  
1403  
1404  
1405  
1406  
1407  
1408  
1409  
1410  
1411  
1412  
1413  
1414  
1415  
1416  
1417  
1418  
1419  
1420  
1421  
1422  
1423  
1424  
1425  
1426  
1427  
1428  
1429  
1430  
1431  
1432  
1433  
1434  
1435  
1436  
1437  
1438  
1439  
1440  
1441  
1442  
1443  
1444  
1445  
1446  
1447  
1448  
1449  
1450  
1451  
1452  
1453  
1454  
1455  
1456  
1457  
1458  
1459  
1460  
1461  
1462  
1463  
1464  
1465  
1466  
1467  
1468  
1469  
1470  
1471  
1472  
1473  
1474  
1475  
1476  
1477  
1478  
1479  
1480  
1481  
1482  
1483  
1484  
1485  
1486  
1487  
1488  
1489  
1490  
1491  
1492  
1493  
1494  
1495  
1496  
1497  
1498  
1499  
1500  
1501  
1502  
1503  
1504  
1505  
1506  
1507  
1508  
1509  
1510  
1511  
1512  
1513  
1514  
1515  
1516  
1517  
1518  
1519  
1520  
1521  
1522  
1523  
1524  
1525  
1526  
1527  
1528  
1529  
1530  
1531  
1532  
1533  
1534  
1535  
1536  
1537  
1538  
1539  
1540  
1541  
1542  
1543  
1544  
1545  
1546  
1547  
1548  
1549  
1550  
1551  
1552  
1553  
1554  
1555  
1556  
1557  
1558  
1559  
1560  
1561  
1562  
1563  
1564  
1565  
1566  
1567  
1568  
1569  
1570  
1571  
1572  
1573  
1574  
1575  
1576  
1577  
1578  
1579  
1580  
1581  
1582  
1583  
1584  
1585  
1586  
1587  
1588  
1589  
1590  
1591  
1592  
1593  
1594  
1595  
1596  
1597  
1598  
1599  
1600  
1601  
1602  
1603  
1604  
1605  
1606  
1607  
1608  
1609  
1610  
1611  
1612  
1613  
1614  
1615  
1616  
1617  
1618  
1619  
1620  
1621  
1622  
1623  
1624  
1625  
1626  
1627  
1628  
1629  
1630  
1631  
1632  
1633  
1634  
1635  
1636  
1637  
1638  
1639  
1640  
1641  
1642  
1643  
1644  
1645  
1646  
1647  
1648  
1649  
1650  
1651  
1652  
1653  
1654  
1655  
1656  
1657  
1658  
1659  
1660  
1661  
1662  
1663  
1664  
1665  
1666  
1667  
1668  
1669  
1670  
1671  
1672  
1673  
1674  
1675  
1676  
1677  
1678  
1679  
1680  
1681  
1682  
1683  
1684  
1685  
1686  
1687  
1688  
1689  
1690  
1691  
1692  
1693  
1694  
1695  
1696  
1697  
1698  
1699  
1700  
1701  
1702  
1703  
1704  
1705  
1706  
1707  
1708  
1709  
1710  
1711  
1712  
1713  
1714  
1715  
1716  
1717  
1718  
1719  
1720  
1721  
1722  
1723  
1724  
1725  
1726  
1727  
1728  
1729  
1730  
1731  
1732  
1733  
1734  
1735  
1736  
1737  
1738  
1739  
1740  
1741  
1742  
1743  
1744  
1745  
1746  
1747  
1748  
1749  
1750  
1751  
1752  
1753  
1754  
1755  
1756  
1757  
1758  
1759  
1760  
1761  
1762  
1763  
1764  
1765  
1766  
1767  
1768  
1769  
1770  
1771  
1772  
1773  
1774  
1775  
1776  
1777  
1778  
1779  
1780  
1781  
1782  
1783  
1784  
1785  
1786  
1787  
1788  
1789  
1790  
1791  
1792  
1793  
1794  
1795  
1796  
1797  
1798  
1799  
1800  
1801  
1802  
1803  
1804  
1805  
1806  
1807  
1808  
1809  
1810  
1811  
1812  
1813  
1814  
1815  
1816  
1817  
1818  
1819  
1820  
1821  
1822  
1823  
1824  
1825  
1826  
1827  
1828  
1829  
1830  
1831  
1832  
1833  
1834  
1835  
1836  
1837  
1838  
1839  
1840  
1841  
1842  
1843  
1844  
1845  
1846  
1847  
1848  
1849  
1850  
1851  
1852  
1853  
1854  
1855  
1856  
1857  
1858  
1859  
1860  
1861  
1862  
1863  
1864  
1865  
1866  
1867  
1868  
1869  
1870  
1871  
1872  
1873  
1874  
1875  
1876  
1877  
1878  
1879  
1880  
1881  
1882  
1883  
1884  
1885  
1886  
1887  
1888  
1889  
1890  
1891  
1892  
1893  
1894  
1895  
1896  
1897  
1898  
1899  
1900  
1901  
1902  
1903  
1904  
1905  
1906  
1907  
1908  
1909  
1910  
1911  
1912  
1913  
1914  
1915  
1916  
1917  
1918  
1919  
1920  
1921  
1922  
1923  
1924  
1925  
1926  
1927  
1928  
1929  
1930  
1931  
1932  
1933  
1934  
1935  
1936  
1937  
1938  
1939  
1940  
1941  
1942  
1943  
1944  
1945  
1946  
1947  
1948  
1949  
1950  
1951  
1952  
1953  
1954  
1955  
1956  
1957  
1958  
1959  
1960  
1961  
1962  
1963  
1964  
1965  
1966  
1967  
1968  
1969  
1970  
1971  
1972  
1973  
1974  
1975  
1976  
1977  
1978  
1979  
1980  
1981  
1982  
1983  
1984  
1985  
1986  
1987  
1988  
1989  
1990  
1991  
1992  
1993  
1994  
1995  
1996  
1997  
1998  
1999  
2000  
2001  
2002  
2003  
2004  
2005  
2006  
2007  
2008  
2009  
2010  
2011  
2012  
2013  
2014  
2015  
2016  
2017  
2018  
2019  
2020  
2021  
2022  
2023  
2024  
2025  
2026  
2027  
2028  
2029  
2030  
2031  
2032  
2033  
2034  
2035  
2036  
2037  
2038  
2039  
2040  
2041  
2042  
2043  
2044  
2045  
2046  
2047  
2048  
2049  
2050  
2051  
2052  
2053  
2054  
2055  
2056  
2057  
2058  
2059  
2060  
2061  
2062  
2063  
2064  
2065  
2066  
2067  
2068  
2069  
2070  
2071  
2072  
2073  
2074  
2075  
2076  
2077  
2078  
2079  
2080  
2081  
2082  
2083  
2084  
2085  
2086  
2087  
2088  
2089  
2090  
2091  
2092  
2093  
2094  
2095  
2096  
2097  
2098  
2099  
2100  
2101  
2102  
2103  
2104  
2105  
2106  
2107  
2108  
2109  
2110  
2111  
2112  
2113  
2114  
2115  
2116  
2117  
2118  
2119  
2120  
2121  
2122  
2123  
2124  
2125  
2126  
2127  
2128  
2129  
2130  
2131  
2132  
2133  
2134  
2135  
2136  
2137  
2138  
2139  
2140  
2141  
2142  
2143  
2144  
2145  
2146  
2147  
2148  
2149  
2150  
2151  
2152  
2153  
2154  
2155  
2156  
2157  
2158  
2159  
2160  
2161  
2162  
2163  
2164  
2165  
2166  
2167  
2168  
2169  
2170  
2171  
2172  
2173  
2174  
2175  
2176  
2177  
2178  
2179  
2180  
2181  
2182  
2183  
2184  
2185  
2186  
2187  
2188  
2189  
2190  
2191  
2192  
2193  
2194  
2195  
2196  
2197  
2198  
2199  
2200  
2201  
2202  
2203  
2204  
2205  
2206  
2207  
2208  
2209  
2210  
2211  
2212  
2213  
22

What is claimed is:

1. An optical measurement system comprising a plurality of light irradiation portions, light from said light irradiation portions being irradiated onto a body to be inspected; and a  
5 plurality of detecting portions for detecting light from said body to be inspected, which further comprises:

a display portion for displaying box-shaped pictures for indicating positions of said irradiation positions or said detecting portions;

- 10 a display portion for displaying box-shaped pictures for indicating measurement positions located between said irradiation positions and said detecting portions; and

- a function to detect that either of said irradiation position or said detecting portion does not have a function of  
15 irradiation or detection and to change the box-shaped picture indicating one of said measurement positions corresponding to said irradiation position and said detecting position.

2. An optical measurement method comprising:

- 20 a process for indicating an irradiation position and a light detecting position;

a process for indicating a measurement position and a states of allocating number to said measurement position; and

- a process for disposing said processes in a screen of a  
25 display portion.

3. An optical measurement system comprising on a screen:

a specifying portion for specifying a selected mode;

a display portion for displaying number of measurement

points; a display portion for indicating a light irradiation position and a light detecting position;

a measurement position display portion composed of portions for displaying a measurement position and a states of

5 allocating number to said measurement position;

a measurement display portion for displaying measuring time sequence data; a portion for setting a condition of acquiring data;

10 a portion for displaying a status of acquiring said data; an instruction portion for instructing control of measurement; and

a mark instruction portion for marking a mark at a position on said measurement instruction portion.

15 4. An optical measurement system according to claim 3, wherein said portion for setting a condition of acquiring data comprises a portion for specifying and displaying a time interval of acquiring data by a light signal from a body to be inspected; a display portion for indicating number of acquiring  
20 said data; and a display portion for indicating an elapsing time of measuring said data.

5. An optical measurement system according to claim 3, wherein said instruction portion for instructing control of  
25 measurement comprises a portion for instructing initiating of measurement; a portion for instructing completing of acquiring said data; and a portion for instructing completing of measurement inspection.

6. An optical measurement system according to claim 3, wherein said measurement display portion is displayed largely and arranged so as to be not overlapped with said measurement position display portion, said portion for setting a condition of acquiring data, said portion for displaying a status of acquiring said data, said instruction portion for instructing control of measurement and said mark instruction portion for marking a mark at a position on said measurement instruction portion.
- 10 7. An optical measurement system comprising:  
an instructing portion for specifying a selected mode;  
a display portion for displaying number of measurement points;  
15 a display portion for indicating a light irradiation position and a light detecting position;  
a measurement position display portion composed of portions for displaying a measurement position and a states of allocating number to said measurement position; and  
20 a display portion for indicating a period during adjusting gain.
8. An optical measurement system comprising on a screen:  
an instructing portion for specifying a selected mode;  
25 a display portion for displaying number of measurement points;  
a display portion for indicating a light irradiation position and a light detecting position;  
a measurement position display portion composed of

portions for displaying a measurement position and a states of allocating number to said measurement position; and  
an abnormality displaying portion.

- 5 9. An optical measurement system according to claim 8,  
wherein said abnormality displaying portion comprises an  
instruction portion for completing an operation under  
progressing; an instruction portion for instructing gain  
adjustment again; and an instruction portion for instructing  
10 to continue the operation by neglecting occurrence of an  
abnormality.
10. An optical measurement system according to claim 8,  
wherein said measurement position display portion is arranged  
15 in a central portion of said screen.
11. An optical measurement system comprising:  
a specifying portion for specifying a selected mode;  
a display portion for displaying number of measuring  
20 times of measurement points;  
a display portion for indicating a light irradiation  
position and a light detecting position;  
a measurement position display portion composed of  
portions for displaying a measurement position and a states of  
25 allocating number to said measurement position;  
a measurement display portion for displaying measuring  
time sequence data; a portion for setting a condition of  
acquiring data;  
a portion for displaying a status of acquiring said data;

an instruction portion for instructing control of measurement; a mark instruction portion for marking a mark at a position on said measurement instruction portion; and

a tentative measurement instruction display portion by  
5 actual signals.

12. An optical measurement system according to claim 11,  
wherein said tentative measurement instruction display portion  
comprises at least an instruction portion for instructing a  
10 magnification of a graph.

13. An optical measurement system comprising:  
a portion for setting a condition of acquiring data;  
a portion for displaying a status of acquiring said data;  
15 an instruction portion for instructing control of  
measurement;  
a mark instruction portion for marking a mark at a  
position on said measurement instruction portion; and  
a display condition input portion.

20

14. An optical measurement system according to claim 13,  
wherein said display condition input portion comprises a  
setting portion for setting a display magnification and a  
display time.

25

15. An optical measurement method comprising:  
a process for setting measurement input conditions  
through a process to instruct an optical measurement mode;  
a process to register a condition of a body to be

inspected; and

a process to set a condition of stimulation.

16. An optical measurement method comprising:

5 a initial display process for selectively instructing any one of selection of optical measurement, analysis of said optical measurement result and completion of a program;

a process for inputting items of condition including a measurement mode; a process for displaying a state expressing  
10 relationship among light irradiation positions and light detection positions and measurement positions so as to meet said mode;

a process for instructing to form a file for storing said optical measurement result;

15 a process for instructing a measurement condition to detect light signals from the inside of a body to be inspected which is irradiated by a multi-wavelength multi-channel; and  
a process for displaying said signals for each channel detected according to said instructing results.

20

17. An optical measurement method comprising:

a process for specifying a selected mode;

a process for displaying number of measuring times of measurement points; a process for indicating a light  
25 irradiation position and a light detecting position;

a process for displaying a measurement position and a states of allocating number to said measurement position;

a process for displaying measuring time sequence data;  
a process for setting a condition of acquiring data;

a process for displaying a status of acquiring said data;  
 a process for instructing control of measurement; and  
 a process for instructing a mark marking at a position  
 on said measurement instruction portion.

5

18. An optical measurement method comprising:  
 a process for specifying a selected mode;  
 a process for displaying number of measuring times of  
 measurement points; a process for indicating a light  
 10 irradiation position and a light detecting position;  
 a process for displaying a measurement position and a  
 states of allocating number to said measurement position; and  
 a process for indicating a period during adjusting gain.

15

19. An optical measurement method comprising:  
 a process for specifying a selected mode;  
 a process for displaying number of measuring times of  
 measurement points;

20

a process for indicating a light irradiation position and  
 a light detecting position;

25

a process for displaying a measurement position and a  
 states of allocating number to said measurement position;  
 a process for displaying measuring time sequence data;  
 a process for setting a condition of acquiring data;  
 a process for displaying a status of acquiring said data;  
 an process for instructing control of measurement;  
 a process for instructing a mark marking at a position  
 on said measurement instruction portion; and  
 a process for instructing tentative measurement by an





## ABSTRACT OF THE DISCLOSURE

In order to provided an optical measurement system and an optical measurement method which is suitable for optically measuring a body to be inspected and easily obtaining an image of a desired item based on information obtained by the measurement, an optical measurement method comprising an initial display process for selectively instructing any one of selection of optical measurement, analysis of said optical measurement result and completion of a program (S1); a process for inputting items of condition including a measurement mode (S2); a process for displaying a light irradiation position and a light detection position and a state expressing measurement position relationship together with said mode (S4); a process for instructing to form a file for storing said optical measurement result; a process for instructing a measurement condition to detect light signals from the inside of a body to be inspected which is irradiated by a multi-wavelength multi-channel (S10); and a process for displaying said signals for each channel detected according to said instructed result (S11).

FIG. 1

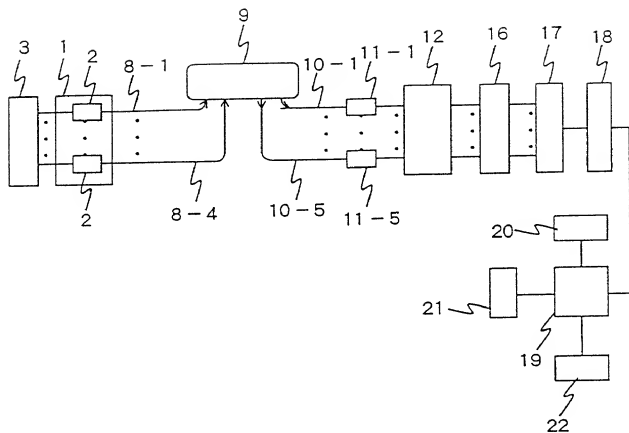


FIG. 2

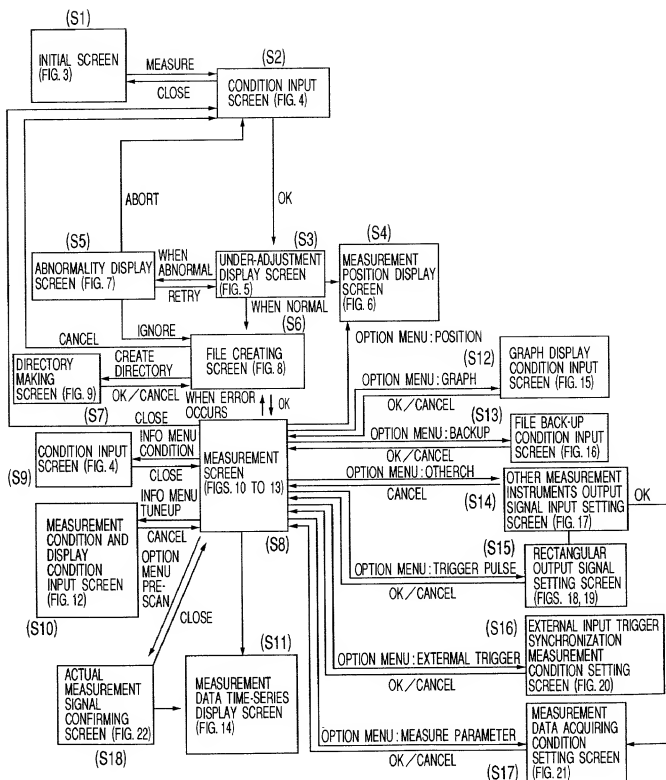


FIG. 3

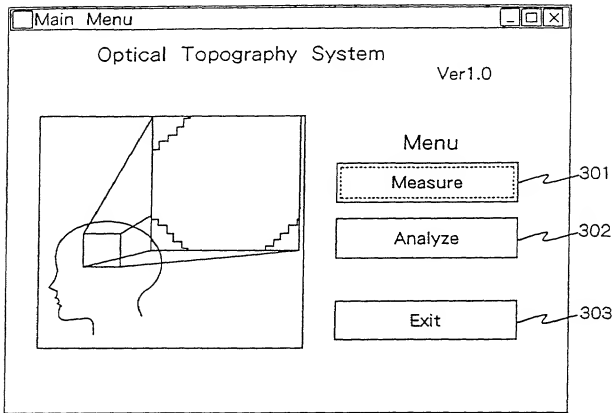


FIG. 4

The screenshot shows a software window titled "Condition" with a standard Windows-style title bar (minimize, maximize, close buttons). The window is divided into several sections:

- Title:** A text input field.
- Date:** A text input field showing "01/12/98 10:54:44".
- Stimulation:** A section containing a text input field with "c", a dropdown menu, and a "Remove" button.
- Measure Mode:** A dropdown menu showing "Model (12points\*2)".
- Memo:** A large empty text area.
- Subject:** A section on the right containing:
  - Name:** A text input field with "tag".
  - Age:** A text input field with "33".
  - Gender:** Radio buttons for "Male" (selected) and "Female".
  - Role:** Radio buttons for "Healthy Volunteer" (selected) and "Patient".
- Buttons:** "OK" and "Close" buttons at the bottom right.

Reference numerals point to various elements: 401 points to the title bar, 402 to the Title field, 403 to the Stimulation section, 404 to the Remove button, 405 to the Date field, 406 to the Memo area, 407 to the Name field, 408 to the Age field, 409 to the Gender radio buttons, 410 to the Role radio buttons, 411 to the OK button, and 412 to the Close button.

FIG. 5

The screenshot shows an "Information" dialog box with a standard Windows-style title bar (minimize, maximize, close buttons). The dialog box contains:

- Icon:** A circular icon with an exclamation mark, indicating a warning or important message.
- Text:** The message "Adjusting Gain. Wait a minute."

FIG. 6

Position

Face1

Label  601

No of Measure CH :  602

<input checked="" type="checkbox"/>	1	<input checked="" type="checkbox"/>	2	<input checked="" type="checkbox"/>	3	<input checked="" type="checkbox"/> 603
4		5		6		7 604
<input checked="" type="checkbox"/>	8	<input checked="" type="checkbox"/>	9	<input checked="" type="checkbox"/>	10	<input checked="" type="checkbox"/>
11		12		13		14
<input checked="" type="checkbox"/>	15	<input checked="" type="checkbox"/>	16	<input checked="" type="checkbox"/>	17	<input checked="" type="checkbox"/>
18		19		20		21
<input checked="" type="checkbox"/>	22	<input checked="" type="checkbox"/>	23	<input checked="" type="checkbox"/>	24	<input checked="" type="checkbox"/>

605

FIG. 7

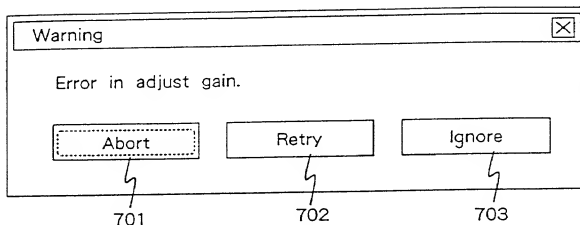


FIG. 8

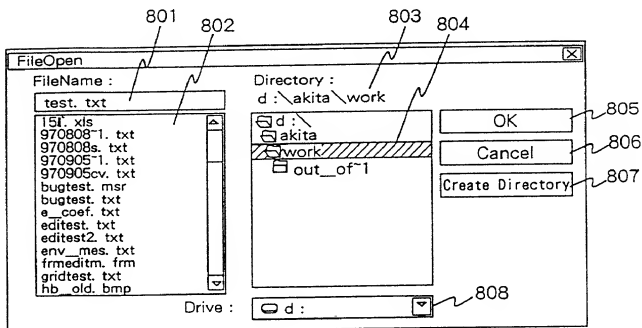




FIG. 9

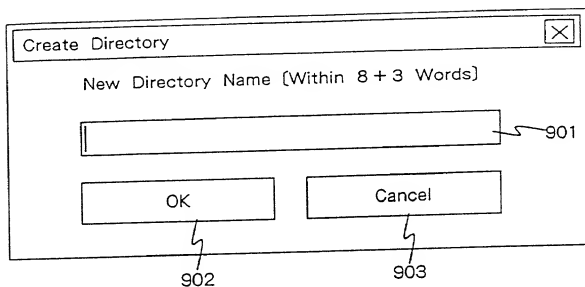


FIG. 10

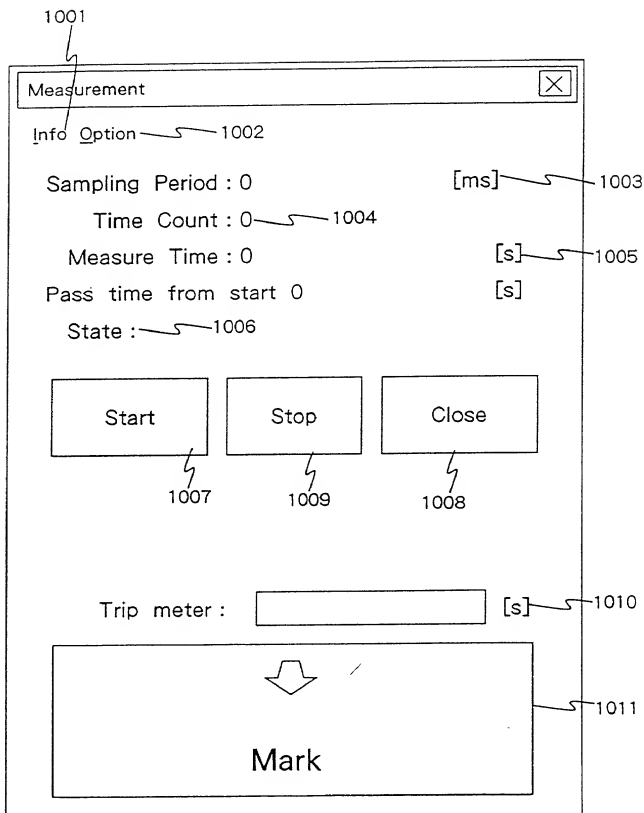


FIG. 11

The image shows a screenshot of a software window titled "Measurement". Inside the window, there is a horizontal bar with two buttons: "Info" and "Optin". Below this bar is a large rectangular area containing two lines of text: "Condition Ctrl + C" and "Tuneup Ctrl + U". At the bottom of the window, the text "Measure Time :" is displayed.

Measurement

Info Optin

Condition Ctrl + C  
Tuneup Ctrl + U

Measure Time :

10/22

FIG. 12

Figure 1 shows a software interface for configuring a spectrum analyzer. The interface includes a frequency scale at the top (1202 to 1208), a 'Tuneup' button (1209), and a 'Qpoint' button (1210). Below these is a table (1211) with columns: A/D CH, Use, Measure CH, Resource Type, Wavelength (nm), A/D Range, Lock in Amp Gain, and Visible. The table lists 24 channels (CH1 to CH24) with various settings. At the bottom, there are control panels for 'A/D Range' (1212), 'Lock in Amp Gain' (1213), 'Use' (1214), and 'Display Mode' (1215), each with radio button options. 'OK' and 'Cancel' buttons are also present.

A/D CH	Use	Measure CH	Resource Type	Wavelength (nm)	A/D Range	Lock in Amp Gain	Visible
CH1	True	1	Optical	780	+/- 1.00	1	True
CH3	True	2	Optical	780	+/- 1.00	1	True
CH7	True	3	Optical	780	+/- 1.00	1	True
CH5	True	4	Optical	780	+/- 1.00	1	True
CH13	True	5	Optical	780	+/- 1.00	1	True
CH9	True	6	Optical	780	+/- 1.00	1	True
CH15	True	7	Optical	780	+/- 1.00	1	True
CH11	True	8	Optical	780	+/- 1.00	1	True
CH19	True	9	Optical	780	+/- 1.00	1	True
CH17	True	10	Optical	780	+/- 1.00	1	True
CH21	True	11	Optical	780	+/- 1.00	1	True
CH23	True	12	Optical	780	+/- 1.00	1	True
CH25	True	13	Optical	780	+/- 1.00	1	True
CH27	True	14	Optical	780	+/- 1.00	1	True
CH31	True	15	Optical	780	+/- 1.00	1	True
CH29	True	16	Optical	780	+/- 1.00	1	True
CH37	True	17	Optical	780	+/- 1.00	1	True
CH33	True	18	Optical	780	+/- 1.00	1	True
CH39	True	19	Optical	780	+/- 1.00	1	True
CH35	True	20	Optical	780	+/- 1.00	1	True
CH43	True	21	Optical	780	+/- 1.00	1	True
CH41	True	22	Optical	780	+/- 1.00	1	True
CH45	True	23	Optical	780	+/- 1.00	1	True
CH47	True	24	Optical	780	+/- 1.00	1	True

At the bottom of the interface, there are control panels for 'A/D Range' (1212), 'Lock in Amp Gain' (1213), 'Use' (1214), and 'Display Mode' (1215), each with radio button options. 'OK' and 'Cancel' buttons are also present.

FIG. 13

Measurement	
Option	
<u>G</u> raph	Ctrl + G
<u>B</u> ackup	Ctrl + B
<u>O</u> ther CH	Ctrl + O
Pre <u>S</u> can	Ctrl + S
<u>P</u> osition	Ctrl + P
<u>M</u> easure Parameter	Ctrl + M

State :

12/22

FIG. 14

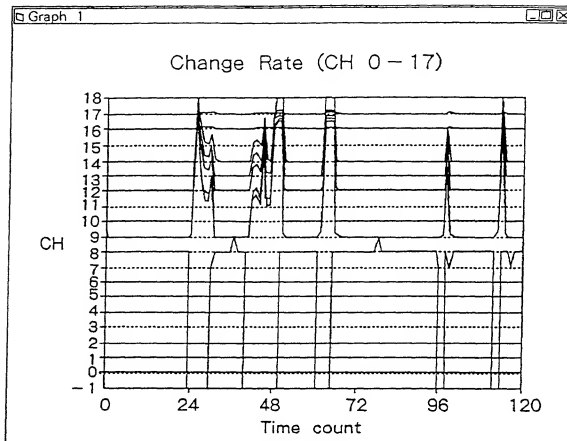


FIG. 15

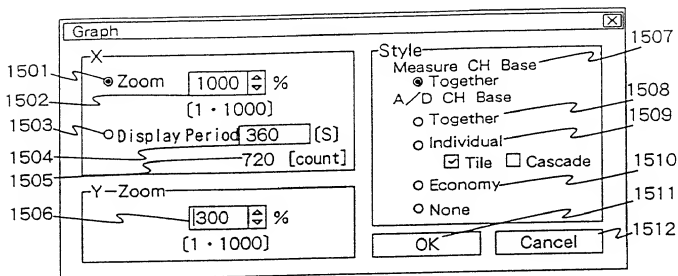


FIG. 16

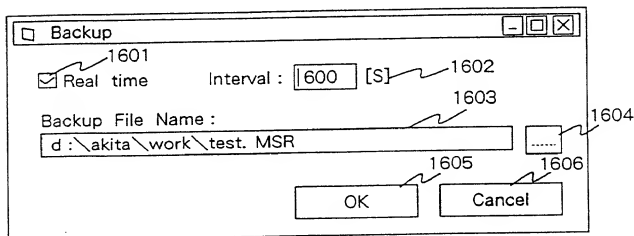


FIG. 17

The image shows a software dialog box titled "Other CH" with a close button (X) in the top right corner. The dialog contains the following elements:

- A label "A/D CH No of Other Input :" followed by a text input field containing the number "49". A callout line labeled 1701 points to this field.
- A label "Resource Type :" followed by an empty text input field. A callout line labeled 1702 points to this field.
- A section titled "A/D Range" containing four radio button options:
  - ☒  $\pm 5.00V$
  - ☐  $\pm 0.10V$
  - ☐  $\pm 1.00V$
  - ☐  $\pm 0.02V$A callout line labeled 1703 points to the "A/D Range" section.
- At the bottom, there are two buttons: "OK" and "Cancel". A callout line labeled 1704 points to the "OK" button, and a callout line labeled 1705 points to the "Cancel" button.



15/22

FIG. 18

Trigger pulse

☐ TriggerPulse 1801

Select COM

☒ COM 1 ☐ COM 2 1802

Initial pulse :  [S] 1803  times 1804

Length of cycle :  [S] 1805

Length of pulse :  [S] 1806

Length of Mark pulse :  [ms] 1807

OK 1808 Cancel 1809

FIG. 19

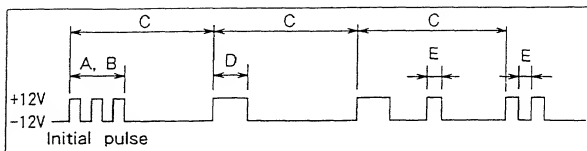


FIG. 20

External Trigger ✕

☐ External Trigger 2001

CH No of External Trigger Line 2002

Length of Each Measure Time 2003

Trigger level [0 - 5.0] 2004

2005

OK 2006

Cancel

17/22

FIG. 21

Measure Parameter

Burst Rate : 48000 [Hz] 2101

Conversion Rate : 1000 [Hz] 2102

Number of Samples : 1 2103

Aquisition Time : 1 [ms] 2104

Sampling Period : 500 [ms] 2105

Total Time of Measurement 2106

3600 [s] 2108

OK 2107

Cancel

FIG. 22

19/22

FIG. 23

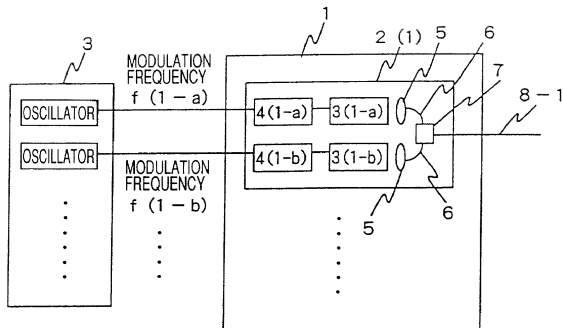


FIG. 24

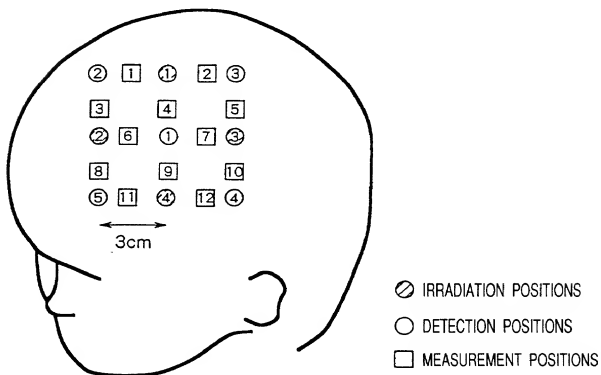


FIG. 25

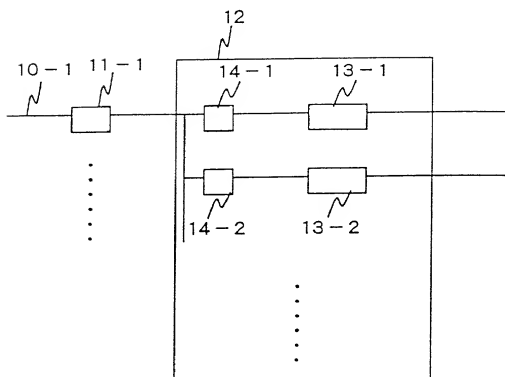


FIG. 26

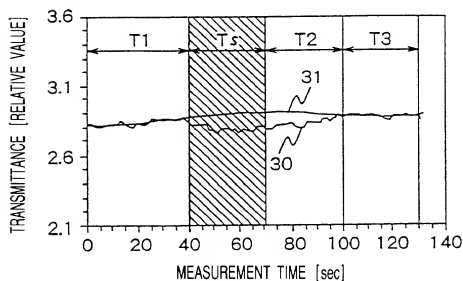


FIG. 27

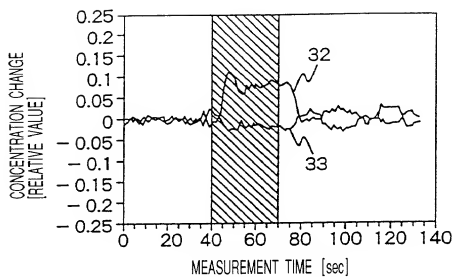
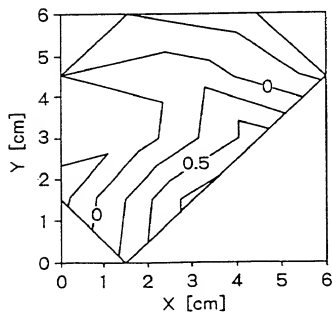


FIG. 28



22/22

FIG. 29

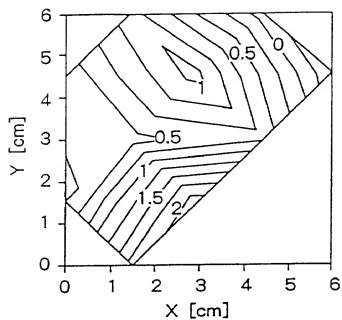
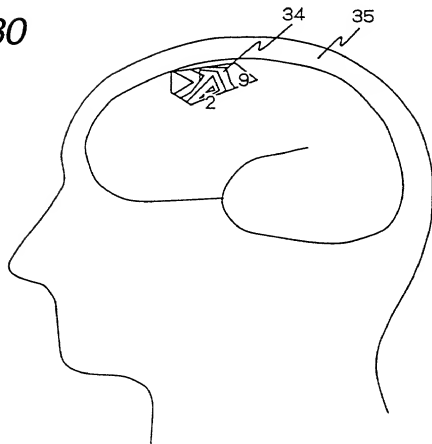


FIG. 30





Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

## Declaration and Power of Attorney For Patent Application

## 特許出願宣言書及び委任状

## Japanese Language Declaration

## 日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載されたと通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

OPTICAL MEASUREMENT INSTRUMENT AND

OPTICAL MEASUREMENT METHOD

上記発明の明細書（下記の欄で×印がついていない場合は、本書に添付）は、

The specification of which is attached hereto unless the following box is checked:

☐ 月 日に提出され、米国出願番号または特許協定条約国際出願番号を \_\_\_\_\_ とし、  
(該当する場合) \_\_\_\_\_ に訂正されました。☒ was filed on 26 / April / 1999  
as United States Application Number or  
PCT International Application Number  
PCT / JP99 / 02207 and was amended on  
5 / October / 1999 (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

# Japanese Language Declaration (日本語宣言書)

私は、米国法典第35編119条(a)-(d)項又は365条(b)項に基づき下記の、米国以外の国の少なくとも一カ国を指定している特許協力条約365(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

## Prior Foreign Application(s)

外国での先行出願

10-134649  
(Number)  
(番号)

Japan  
(Country)  
(国名)

28/April/1998  
(Day/Month/Year Filed)  
(出願年月日)

Priority Not Claimed

優先権主張なし

(Number)  
(番号)

(Country)  
(国名)

(Day/Month/Year Filed)  
(出願年月日)

私は、第35編米国法典119条(e)項に基づいて下記の米  
国特許出願規定に記載された権利をここに主張いたします。

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

私は、下記の米国法典第35編120条に基づいて下記の米  
国特許出願に記載された権利、又は米国を指定している特許  
協力条約365条(c)項に基づき権利をここに主張します。ま  
た、本出願の各請求範囲の内容が米国法典第35編112条  
第1項又は特許協力条約で規定された方法で先行する米国特  
許出願に開示されていない限り、その先行米国出願書提出日  
以降で本出願書の日本国内または特許協力条約国際提出日ま  
での期間中に入手された、連邦規則法典第37編1条56項  
で定義された特許資格の有無に関する重要な情報について開  
示義務があることを認識しています。

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

(Status: Patented, Pending, Abandoned)  
(現況: 特許許可済、係属中、放棄済)

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

(Status: Patented, Pending, Abandoned)  
(現況: 特許許可済、係属中、放棄済)

私は、私自身の知識に基づいて本宣言書中で私が行なう表  
明が真実であり、かつ私の入手した情報と私の信じることに  
基づく表明が全て真実であると信じていること、さらに故  
意になされた虚偽の表明及びそれと同等の行為は米国法典第  
18編第1001条に基づき、罰金または拘禁、もしくはそ  
の両方により処罰されること、そしてそのような故意による  
虚偽の表明を行えば、出願した、又は既に許可された特許  
の有効性が失われることを認識し、よってここに上記のごと  
く宣誓を致します。

I hereby declare that all statements made herein of my own  
knowledge are true and that all statements made on information  
and belief are believed to be true; and further that these  
statements were made with the knowledge that willful false  
statements and the like so made are punishable by fine or  
imprisonment, or both, under Section 1001 of Title 18 of the  
United States Code and that such willful false statements may  
jeopardize the validity of the application or any patent issued  
thereon.

Under the Paperwork Reduction Act of 1995, no persons are required to provide information unless it displays a valid OMB control number.

# Japanese Language Declaration

## (日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の  
手続きを米特許商標局に対して遂行する弁理士または代理人  
として、下記の者を指名いたします。(弁理士、または代理  
人の氏名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint  
the following attorney(s) and/or agent(s) to prosecute this application  
and transact all business in the Patent and Trademark Office  
connected therewith (list name and registration number)

John R. Mattingly, Reg. No. 30,293;  
Daniel J. Stanger, Reg. No. 32,846  
Shrinath Malur, Reg. No. 34,663;  
Gene W. Stockman, Reg. No. 21,021  
Jeffrey M. Ketchum, Reg. No. 31,174;  
and Scott W. Brickner, Reg. No. 34,553.

書類送付先

Send Correspondence to:

Mattingly, Stanger & Malur, P.C.  
104 East Hume Avenue  
Alexandria, Virginia 22301

直接電話連絡先：(名前及び電話番号)

Direct Telephone Calls to: (name and telephone number)

Telephone: (703) 684-1120  
Fax: (703) 684-1157

唯一または第一発明者名	Full name of sole or first inventor Atsushi MAKI	
発明者の署名	日付	Inventor's signature Date
		9/25/2000
住所	Residence Hachioji, Japan JPY	
国籍	Citizenship Japan	
私書箱	Post Office Address c/o Hitachi, Ltd., Intellectual Property Group New Marunouchi Bldg. 5-1, Marunouchi 1-chome, Chiyoda-ku, Tokyo 100-8220, Japan	

(第二以降の共同発明者についても同様に記載し、署名をす  
ること)

(Supply similar information and signature for second and  
subsequent joint inventors.)

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

第二共同発明者名	200	Full name of second joint inventor, if any	
第二共同発明者の署名	日付	Yuichi YAMASHITA	
		Second inventor's signature	Date
		山手 優一	9/25/2000
住所		Residence	
		Kawagoe, Japan	JPX
国籍		Citizenship	
		Japan	
私書箱		Post Office Address	
		c/o Hitachi, Ltd., Intellectual Property Group	
		New Marunouchi Bldg. 5-1, Marunouchi 1-chome,	
		Chiyoda-ku, Tokyo 100-8220, Japan	
第三共同発明者名	300	Full name of third joint inventor, if any	
第三共同発明者の署名	日付	Tsuyoshi YAMAMOTO	
		Third inventor's signature	Date
		山本 剛	9/25/2000
住所		Residence	
		Hatoyama, Japan	JPX
国籍		Citizenship	
		Japan	
私書箱		Post Office Address	
		c/o Hitachi, Ltd., Intellectual Property Group	
		New Marunouchi Bldg. 5-1, Marunouchi 1-chome,	
		Chiyoda-ku, Tokyo 100-8220, Japan	
第四共同発明者名	400	Full name of fourth joint inventor, if any	
第四共同発明者の署名	日付	Hideaki KOIZUMI	
		Fourth inventor's signature	Date
		小泉 英明	9/26/2000
住所		Residence	
		Tokyo, Japan	JPX
国籍		Citizenship	
		Japan	
私書箱		Post Office Address	
		c/o Hitachi, Ltd., Intellectual Property Group	
		New Marunouchi Bldg. 5-1, Marunouchi 1-chome,	
		Chiyoda-ku, Tokyo 100-8220, Japan	
第五共同発明者名		Full name of fifth joint inventor, if any	
第五共同発明者の署名	日付	Fifth inventor's signature	Date
住所		Residence	
国籍		Citizenship	
私書箱		Post Office Address	